99C-133

Proposal Title:	Developing a Biological and Genetic Management Plan for Chinook Salmon in the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones
Applicant Name:	Kier Associates
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Amount of funding requested: $482,289 for 2 years

Indicate the Topic for which you are applying (check only one box).

- ☐ Fish Passage/Fish Screens
- ☐ Habitat Restoration
- ☐ Local Watershed Stewardship
- ☐ Water Quality
- ☐ Introduced Species
- ☑ Fish management/hatchery
- ☐ Environmental Education

Does The Proposal Address A Specific Focused Action? ✓ YES _____ NO

What county or counties is the project located in? Shasta, Tehama

Indicate the geographic area of your proposal (check only one box):

- ☑ Sacramento River Mainstem
- ☐ Sacramento Trib: _____
- ☐ San Joaquin River Mainstem
- ☐ San Joaquin Trib: _____
- ☐ Delta _____
- ☐ East Side Trib: _____
- ☐ Suisun Marsh and Bay
- ☐ North Bay/South Bay: _____
- ☐ Landscape (entire Bay-Delta watershed)
- ☐ Other

Indicate the primary species which the proposal addresses (check all that apply)

- ☐ San Joaquin and East Side Delta tributaries fall-run chinook salmon
- ☑ Winter-run chinook salmon
- ☑ Late-fall run chinook salmon
- ☐ Delta smelt
- ☐ Splittail
- ☐ Green sturgeon
- ☐ Migratory birds
- ☐ Other _____
- ☑ Spring-run chinook salmon
- ☑ Fall-run chinook salmon
- ☐ Longfin smelt
- ☐ Steelhead trout
- ☐ Striped bass
- ☑ All chinook species
- ☐ All anadromous salmonids

Specify the ERP strategic objective and target(s) that the project addresses. Include the page numbers from January 1999 version of ERP Volume I and II:

This project addresses several CALFED actions and goals including: a "Focused Action" on page 28 of the Proposal Solicitation Package; it will assist the recovery of "at-risk" salmon species by developing a plan that considers unique genetic characteristics of various populations (ERP Vol. II, page 1; Strategic Plan, Goal 1, pages 28 – 30); it will protect biodiversity and allow for restoration of the "natural biotic community" by genetically identifying, and resolving the management of, individual stocks of chinook salmon that could otherwise be lost or overlooked (Strategic Plan, Goal 2, pages 28 – 30); it will also foster the maintenance and enhancement of populations of salmon for commercial and recreational harvest by specifically including representatives of these two stakeholder groups in the development of the management plan for chinook salmon (ERP Vol. II, page 1; Strategic Plan, Goal 3, pages 29 – 30); this project will revise extinction models for sensitive chinook stocks which will help achieve the target of ensuring the continued existence of winter-run chinook (ERP Vol. II page 26); and this project will help the goal of restoring spring-run chinook by investigating the "introgression with fall-run" that is cited as a factor affecting the status of these fish (ERP Vol. II, page 27).

Indicate the type of applicant (check only one box):

- ☐ State agency
- ☐ Public/Non-profit joint venture
- ☐ Local government/district
- ☐ University
- ☐ Federal agency
- ☐ Non-profit
- ☐ Private party
- ☑ Other - Private/University Joint Venture

Indicate the type of project (check only one box):

- ☑ Planning
- ☐ Monitoring
- ☐ Research
- ☐ Implementation
- ☐ Education

By signing below, the applicant declares the following:

1.) The truthfulness of all representations in their proposal;

2.) The individual signing the form is entitled to submit the application on behalf of the applicant (if the applicant is an entity or organization): and

3.) The person submitting the application has read and understood the conflict of interest and confidentiality discussion in the PSP (Section 2.4) and waives any and all rights to privacy and confidentiality of the proposal on behalf of the applicant, to the extent as provided in the Section.

William M. Kier
Printed name of applicant

William M. Kier
Signature of applicant

I-018030

DEVELOPING A BIOLOGICAL AND GENETIC MANAGEMENT PLAN FOR CHINOOK SALMON IN THE NORTHERN SACRAMENTO VALLEY AND BUTTE BASIN ECOSYSTEM MANAGEMENT ZONES

Submitted by:

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Project Participants and Collaborators

Kier Associates – Kier Associates will take the lead role in proposal submittal, contract administration, project management, project facilitation, and monitoring. Kier Associates will prepare a biological and genetic management plan for chinook salmon in the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones. Kier Associates will facilitate the agency and stakeholder Genetic Conservation Advisory Team to oversee the genetic research and preparation of the biological and genetic management plan. This team will be made up of technical experts and management directors from state and federal agencies, and stakeholder groups.

University of California, Davis – Bodega Marine Laboratory – Researchers under the supervision of Dr. Dennis Hedgecock will conduct DNA analyses for describing, monitoring, and managing chinook salmon populations from Battle, Butte, and Clear creeks, and the Sacramento River.

California Department of Fish and Game (CDFG) strongly supports the development of a biological and genetic management plan for chinook salmon. This proposal is consistent with all the Department's plans for winter-run, spring-run, fall-run and late-fall-run chinook salmon. CDFG will participate on the Genetic Conservation Advisory Team and will assist with collection and archiving of genetic samples through on-going collection efforts. U.S. Fish and Wildlife Service (USFWS) strongly supports the development of a biological and genetic management plan for chinook salmon. This project's objectives and goals are consistent with all of the Services plans for anadromous fish in the Sacramento River. USFWS will participate on the Genetic Conservation Advisory Team and will assist with collection and archiving of genetic samples through on-going collection efforts.

National Marine Fisheries Service (NMFS), U.S. Bureau of Reclamation (USBR), and the California Department of Water Resources (CDWR) will participate on the Genetic Conservation Advisory Team. Additionally, stakeholders interested in the restoration and management of fisheries in the Sacramento River watershed will also be invited to participate on the Genetic Conservation Advisory Team. These stakeholders may include local watershed conservancies, commercial and sport fishing industry representatives, water users, and environmental groups.

Executive Summary

Large-scale, fish habitat restoration programs that will allow chinook salmon access to historic habitats are now underway. These programs must insure that the recolonization of restored habitats proceeds in a manner which protects the genetic diversity of target salmonid populations. Recent advances in our understanding of the genetics of chinook salmon have been significant but are presently insufficient for guiding the types of management decisions that must be made concurrently with the implementation of ongoing restoration programs. Therefore, the fisheries management community must rapidly develop deeper insight into the genetics of the Central Valley's chinook salmon populations, and use new and existing information to forge management policies that will form the basis for salmonid management well into the 21st Century.

Kier Associates and the University of California, Davis, propose to develop a biological and genetic management plan for the restoration and recolonization of streams in the Central Valley by chinook salmon. The development of this management plan will be accomplished with two parallel initiatives including a management policy initiative and a genetic research program. The management policy initiative will coordinate existing management policies with the novel conservation needs encountered in restored ecosystems of the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones, and will reconcile existing and new conservation genetics results with competing management priorities including the harvest needs of commercial and sport fisheries, concerns under the federal and state endangered species acts (ESA and CESA, respectively), CALFED Strategic Goals, mitigation obligations, hatchery policies, and the needs of non-fisheries water users and conservationists. The parallel genetic research program will conduct additional analyses to improve race discrimination in chinook salmon and answer genetic concerns vital to the restoration and conservation of salmon.

The primary benefits of the proposed project will be: 1) an advanced understanding of the genetics of salmon populations, 2) a management plan that will lead to improved ways to conserve dwindling fish stocks, including several listed under state and federal ESAs, 3) a management plan with improved methods for minimizing impacts of fish-protection measures on sport and commercial fisheries and water-users, 4) a management plan that will integrate existing mitigation obligations and hatchery policies with Sacramento River fisheries management, 5) a management plan that will create an adaptive-management framework for the recolonization of habitats that are, or soon will be, under restoration, and 6) the protection of over $300 million of fish habitat restoration programs in the upper Sacramento River and tributaries.

The development of the management plan by Kier Associates will be overseen by a Genetic Conservation Advisory Team (GCAT) comprised of agency, stakeholder, and research scientists actively involved in conservation biology and genetic research and management. The GCAT will have flexibility in scoping the genetic conservation and policy research at its outset and will guide the development of genetic management policies, advise and peer-review project-sponsored salmonid genetic research, and review the development of the final biological and genetic management plan. The management plan will be based on new and existing genetic conservation research and existing state and federal policy. The management plan will reconcile competing management priorities including the harvest needs of commercial and sport fisheries, concerns under ESA and CESA, CALFED Strategic Goals, mitigation obligations, and hatchery policies.

The management plan will be supported by new genetic research conducted by Dr. Dennis Hedgecock of the University of California, Davis. Dr. Hedgecock will carry out DNA analyses for

describing, monitoring, and managing chinook salmon in the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones (EMZs). Tissue samples will be taken from chinook salmon in the mainstem Sacramento River and in Battle, Butte, and Clear Creeks, and at Coleman National Fish Hatchery (CNFH). Collection of the majority of these samples will be funded by as part of ongoing fish monitoring programs funded by USFWS and CDFG. A small portion of these samples will be funded by this project and collected by Kier Associates. All genetic samples will be typed for microsatellite DNA markers, as described by Banks et al. (1999 and submitted). These data will provide baseline information on the genetic diversity and integrity of salmon in the two EMZs. We will address a variety of genetic management issues including, but not limited to: overlap, interactions, and genetic integrity of spring and fall chinook in Butte and Clear creeks; subpopulation structure for spring and fall runs in the two EMZs; artificial hybridization between four chinook runs in Battle Creek; and effective sizes and potential genetic resilience of spawning stocks.

The project will cost $482,289 and will be completed within two years of contract initiation. CDFG and USFWS will share additional costs by collecting the majority of the genetic samples through ongoing research and monitoring programs.

The principal investigators, William Kier, Michael Ward, and Dr. Dennis Hedgecock have extensive experience with fisheries management and policy planning, salmon population ecology, and the genetics of Central Valley salmon stocks.

This project addresses several CALFED actions and goals including: a "Focused Action" on page 28 of the Proposal Solicitation Package; it will assist the recovery of "at-risk" salmon species by developing a plan that considers unique genetic characteristics of various populations (ERP Vol. II, page 1; Strategic Plan, Goal 1, pages 28 – 30); it will protect biodiversity and allow for restoration of the "natural biotic community" by genetically identifying, and resolving the management of, individual stocks of chinook salmon that could otherwise be lost or overlooked (Strategic Plan, Goal 2, pages 28 – 30); it will also foster the maintenance and enhancement of populations of salmon for commercial and recreational harvest by specifically including representatives of these two stakeholder groups in the development of the management plan for chinook salmon (ERP Vol. II, page 1; Strategic Plan, Goal 3, pages 29 – 30); this project will revise extinction models for sensitive chinook stocks which will help achieve the target of ensuring the continued existence of winter-run chinook (ERP Vol. II page 26); and this project will help the goal of restoring spring-run chinook by investigating the "introgression with fall-run" that is cited as a factor affecting the status of these fish (ERP Vol. II, page 27).

Project Description

Scope of Work

Project Description: In light of contemporary restoration efforts and their concomitant concerns regarding protection of genetic diversity within recolonizing populations, Kier Associates has teamed with researchers at the University of California, Davis to propose the development of a biological and genetic management plan for the restoration and recolonization of streams in the Central Valley by chinook salmon. The development of our proposed biological and genetic management plan will match the ecological and policy-planning expertise of Kier Associates with the distinguished salmonid genetic authorities and facilities of the University's Bodega Marine Lab (BML).

We propose to develop a biological and genetic management plan for chinook salmon in the Sacramento River and tributaries within the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones (CALFED 1999a) by pursuing two parallel and complementary initiatives comprised of seven inseparable tasks. These two initiatives will be a management policy initiative and a genetic research program. The management policy initiative will coordinate existing management policies with the novel conservation needs encountered in restored ecosystems of the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones, and will reconcile existing and new conservation genetics results with competing management priorities including the harvest needs of commercial and sport fisheries, concerns under the federal and state endangered species acts (ESA and CESA, respectively), CALFED Strategic Goals, mitigation obligations, hatchery policies, and the needs of non-fisheries water users and conservationists. Through facilitation of recent planning efforts in Battle Creek, as well as other watersheds, Kier Associates has learned how to bridge the legitimate differences that exist among the many stakeholders concerned with fisheries restoration and management who have varying backgrounds and responsibilities. Through our management policy initiative, Kier Associates will apply this knowledge and experience to forge management plans that incorporate all stakeholder needs as well as the latest in genetic research. The parallel genetic research program will conduct additional genetic analyses to improve race discrimination in chinook salmon and answer genetic concerns vital to the restoration and conservation of salmon in restored habitats.

Approach: Our management policy initiative will: A) convene and facilitate a Genetic Conservation Advisory Team (GCAT) of agency, stakeholder, and research scientists actively involved in conservation biology and genetic research and management; B) compile and integrate existing policy and research on genetic conservation in salmon; and C) prepare a final stock-specific management plan for the genetic conservation of salmon for individual habitats within the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones. The GCAT will oversee and guide the development of genetic management policies, advise and peer-review new salmonid genetic research, and review the development of the final biological and genetic management plan. This final biological and genetic management plan will include recommendations for minimizing the effects of hatchery releases on naturally-spawned fish, a long-term genetic monitoring plan, recommendations on the use of founders to accelerate recolonization, an adaptive management program for restoration of habitats and species, operational plans and criteria for weirs and fish ladders, updated or new extinction models for all stocks of chinook, and protocols for describing changes in aquatic communities as recolonization proceeds.

The genetic research program will build upon existing understanding of Central Valley chinook salmon genetics and will continue a series of ongoing and recently completed investigations by Dr. Dennis Hedgecock of the University of California, Davis who has been funded for similar work by California Department of Water Resources, CALFED and the USFWS. Dr. Hedgecock will carry out DNA analyses for describing, monitoring, and managing chinook salmon in the Northern Sacramento

Valley and Butte Basin Ecosystem Management Zones (EMZs). Tissue samples will be taken from chinook salmon in the mainstem Sacramento River and in Battle, Butte, and Clear Creeks, and at Coleman National Fish Hatchery (CNFH). Collection of the majority of these samples will be funded by as part of ongoing fish monitoring programs by USFWS and CDFG; a small portion of these samples will be funded by this project and collected by Kier Associates. CDFG organize the collection of all tissue samples according to state archival standards. These samples will be typed for microsatellite DNA markers, as described by Banks et al. (1999 and submitted). These data will provide baseline information on the genetic diversity and integrity of salmon in the two EMZs. We will address a variety of genetic management issues (detailed in Table 2 by run and by watershed), including, but not limited to:

- Overlap, interactions, and genetic integrity of spring and fall chinook in Butte and Clear creeks;
- Subpopulation structure for spring and fall runs in the two EMZs;
- Artificial hybridization between four chinook runs in Battle Creek;
- Effective sizes and potential genetic resilience of spawning stocks.

Results will be summarized in three interim reports and in one final research report to the GCAT. This final research report will be incorporated by Kier Associates in the final biological and genetic management plan.

Agencies and stakeholders participating in the GCAT will have flexibility helping scope the genetic conservation and policy research at its outset, will review its progress, and will review its products. However, fisheries managers need to be assured that research products are completed and reviewed by competent peers before they are used in management planning or decision making. Specifically, we wish to avoid invalid or inappropriate conclusions that once marred genetic research in the Central Valley. Therefore the two initiatives used to develop the biological and genetic management plan will be kept parallel but separate until the genetic research is completed. Kier Associates will act as a bridge between the University's basic research and the potential controversies involved with development of management policies. Once the research is completed, Kier Associates will serve to integrate the research findings into the final management plan with the guidance of the University's researchers and the GCAT.

Tasks: The following narrative describes the objectives of each task. Table 1 provides information about phasing, scheduling, and deliverables.

Task 1 – Genetic Conservation Advisory Team (GCAT): Kier Associates will convene and facilitate a Genetic Conservation Advisory Team of agency, stakeholder, and research scientists actively involved in conservation biology and genetic research and management. An existing and similar panel dedicated to genetic issues known as the Genetics Subteam of the Interagency Ecological Program's Central Valley Salmonid Work Team could possibly be used as the core of the proposed GCAT. This core group consisting of technical experts would likely be augmented by the addition of agency members who focus on broader management and policy decisions, as well as representatives from stakeholder groups and other agencies. The GCAT will decide on its final format and structure (e.g. perhaps it will need to form technical and management sub-teams reflecting individual member's concerns/expertise). This Advisory Team will meet at least five times during the two year project to oversee and guide the development of genetic management policies, advise and peer-review project-sponsored salmonid genetic research, and review the development of the final biological and genetic management plan.

Task 2 – Genetic Conservation and Policy Research: Kier Associates will compile existing research information on genetic conservation in chinook salmon with new findings from research conducted as part

of this project. This information will be integrated with state and federal policy, and will be reconciled with competing management priorities including the harvest needs of commercial and sport fisheries, concerns under the ESA and CESA, CALFED Strategic Goals, mitigation obligations, and hatchery policies.

Task 3 – Sampling: Sampling of salmon for genetic analyses will be carried out by CDFG and USFWS, with field support from Kier Associates in cases where existing labor is insufficient, or in the case that the GCAT reprioritizes some of our proposed samples. Samples will be collected using a variety of methods, depending on the life stage to be sampled (see Table 2). Sampling locations and expected sample sizes are detailed in Table 2.

Task 4 – DNA Analysis: Dr. Hedgecock's laboratory has developed microsatellite DNA markers and pioneered their application to chinook salmon conservation in California's Central Valley (Banks et al. 1996, 1999, submitted; Hedgecock et al., in prep.). These microsatellite DNA markers provide tools that are sensitive enough to reveal differences among very similar populations, including closely related chinook salmon runs. The steps in such analyses include DNA extraction, DNA amplification and genetic typing of individuals, and separation and scoring of DNA markers.

Task 5– Population Analysis and Reporting: A variety of population genetic analyses will be performed, as required by specific management needs (see Table 2) and using available software (see Banks et al. submitted). For adult populations, we will first determine whether they are in equilibrium. If not, we will determine the likely cause (e.g. admixture of two or more runs in collections), by using mixed stock analyses and temporal sampling. For samples of juveniles, we must correct for relatedness, in order to compare populations in different watersheds. We will also estimate effective population sizes from juvenile samples.

Task 6 – Management Plan Preparation: Kier Associates will prepare a final stock- and species-specific management plan for the genetic conservation of salmon for individual habitats within the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones which will include recommendations for minimizing the effects of hatchery releases on naturally-spawned fish, a long-term genetic monitoring plan, recommendations on the use of founders to accelerate recolonization, an adaptive management program for restoration of habitats and species, operational plans and criteria for weirs and fish ladders, updated or new extinction models for all stocks of chinook, and protocols for describing changes in aquatic communities as recolonization proceeds.

Task 7 – Project Management: William Kier will manage the overall project and will coordinate the Genetic Conservation Advisory Team. Michael Ward will be responsible for policy research and plan preparation. Dr. Dennis Hedgecock will supervise the laboratory work and data analyses. He will also serve as the liaison to Kier Associates, in order to integrate genetic information into the management plan.

Project Location

The proposed genetic management plan will be written for stocks of chinook salmon that exist within the Northern Sacramento Valley (Figure 1) and Butte Basin Ecosystem Management Zones (Figure 2). While we cannot provide digital geographic coordinates encompassing the entirety of the two Ecosystem Management Zones (EMZ), or topographic maps of these large areas to the scale specified in the PSP, CALFED geographical information system specialists should already have access to these coordinates as these two EMZs were originally identified and mapped by CALFED. Specific genetic sample collection locations are located on Butte (approx. 39° 45' N, 121° 45' W), Battle (40° 23' 54" N, 122° 8' 43" W), and Clear creeks (approx. 40° 30N, 122° 38' W), as well as the mainstem Sacramento River (approx. 40° 35' N, 122° 38' W).

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Table 1. Task schedule/milestones, roles, and deliverables.

Phase	Task	Completion Date*	Lead	Deliverables
I	Genetic Conservation Advisory Team (GCAT): Meeting 1 – Finalize GCAT structure, review sampling plan, guide genetic conservation and policy research	11/1/99	Kier Associates with agencies and stakeholders	Meeting minutes to be incorporated into Management Plan
	Genetic Conservation and Policy Research	10/1/99-1/15/00	Kier Associates	Draft literature report to be delivered to GCAT
	Sampling	10/1/99 - 12/1/00	CDFG/USFWS	Genetic samples from approx. 3600 chinook
	GCAT: Meeting 2	2/1/00	Kier Associates with agencies and stakeholders	Meeting minutes and review comments to be incorporated into Management Plan
II	DNA Analysis	1/1/00 - 2/1/01	UCD	Summary spreadsheets, 3 interim reports
	GCAT: Meeting 3 – Review preliminary DNA analysis	8/1/00	Kier Associates with agencies and stakeholders	Meeting minutes to be incorporated into Management Plan
III	Population Analysis and Reporting	1/1/00 - 4/1/01	UCD	Final research report
	Management Plan Prep.– Prepare and deliver first review draft	1/15/00 - 6/1/01	Kier Associates	First review draft of Management Plan to GCAT
	GCAT: Meeting 4 – review research findings and first review draft	6/15/01	Kier Associates with agencies and stakeholders	Meeting minutes and review comments to be incorporated into Management Plan
IV	Management Plan Prep.– Prepare and deliver final review draft	6/1/01 - 8/1/01	Kier Associates	Final review draft of Management Plan to GCAT
	GCAT: Meeting 5 – Review research findings and final review draft	6/1/01 - 8/15/01	Kier Associates with agencies and stakeholders	Meeting minutes and review comments to be incorporated into Management Plan
V	Management Plan Prep.– Prepare and deliver final plan	8/15/01 - 9/30/01	Kier Associates	Final Biological and Genetic Management Plan to GCAT
	Project Management	10/1/99-9/30/01	Kier Associates	Quarterly reports to contracting agency and GCAT

* Completion dates assume a 10/1/99 project initiation upon completion of final contract.

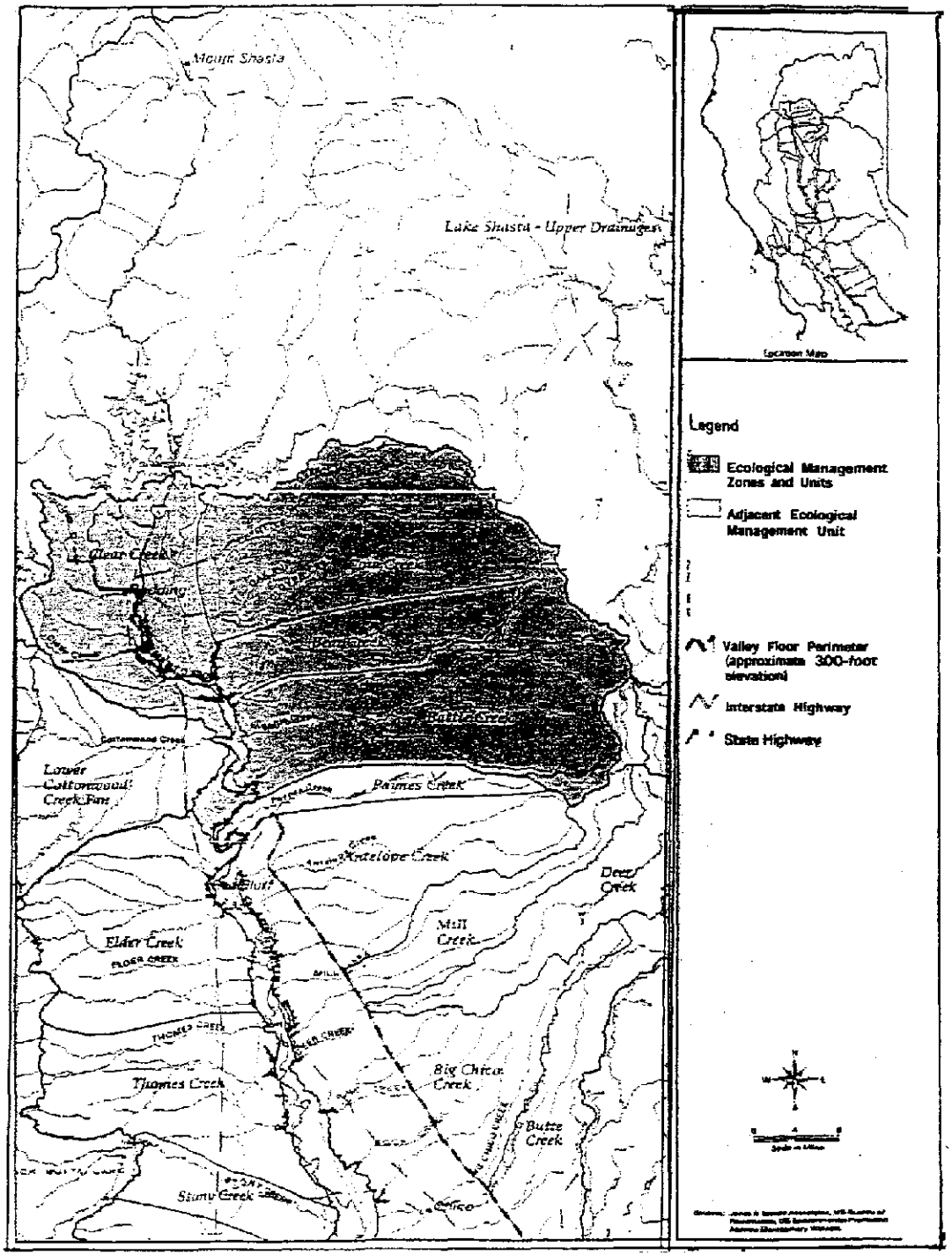

Figure 1. The Northern Sacramento Valley Ecological Management Zone is one of two areas that will be included within the Kier Associates/UC-Davis team's proposed genetic management plan. This area, and the original map, were documented by CalFed in the Ecosystem Restoration Program Plan Maps document.

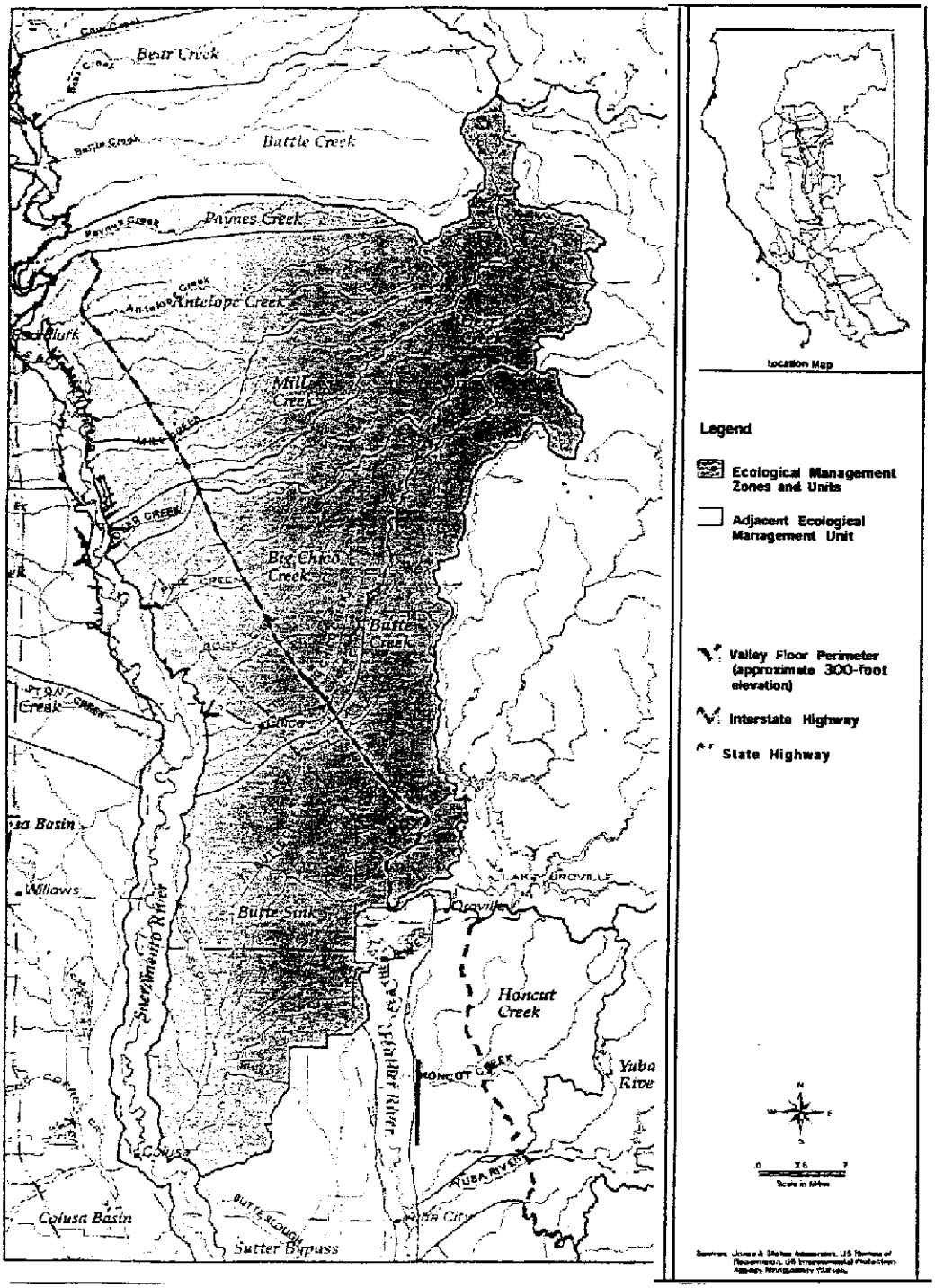

Figure 2. The Butte Basin Ecological Management Zone is the second of two areas that will be included within the Kier Associates/UC-Davis team's proposed genetic management plan. This area, and the original map, were documented by CalFed in the Ecosystem Restoration Program Plan Maps document.

Table 2. Proposed research questions, by watershed and run, to be addressed by researchers at University of California, Davis. The Genetic Conservation Advisory Team will be asked to review and suggest modifications to these questions and other elements of the genetic research program shortly after project initiation.

1) Battle Creek fall-run chinook salmon

Objectives: Determine genetic integrity, overlap with other runs, and causes of disequilibrium; reduce risk of artificial hybridization.

Question	Sampling Protocol	Sampling Schedule
1.1) Did genetic disequilibrium observed in CNFH fall-run chinook stocks in 1993 and 1995 (Banks et al. submitted) persist in years from 1996-2000?	Tissues from CDFG archive, 100 per year for two years (N=200).	Use archived samples for 1996-1998 and use samples from Question 1.3 for 1999 and 2000.
1.2) Is the mainstem Sacramento River fall chinook population in genetic equilibrium? Is any disequilibrium observed in CNFH fall-run chinook observable in mainstem Sacramento River fall chinook (i.e. Is disequilibrium spreading from CNFH to the mainstem?)?	Sample 100 carcasses from mainstem Sacramento River in 1999 & 2000 (N=200), plus samples from Question 1.3.	October and November of 1999 and 2000
1.3) Does observed genetic disequilibrium vary within or between spawning seasons? Is disequilibrium more pronounced during the early and late portions of the fall run, owing to admixture with spring and late-fall chinook? Is there inter-annual variation in overlap and risk of hybridization at CNFH?	Sample 100 adults returning to CNFH, five times within fall run in 1999 and 2000 (N= 1000).	For two years: Sample first 100 adults that return to CNFH (early October); sample 100 fish returning in last week of October; sample 100 fis returning at peak of run (on or about November 15); sample 100 fish the first week of December; sample 100 fish in last week of December.

2) Battle Creek late-fall-run chinook salmon

Objectives: Determine genetic integrity and causes of disequilibrium; reduce risk of artificial hybridization.

Question	Sampling Protocol	Sampling Schedule
2.1) Is there genetic disequilibrium in the CNFH late-fall-run chinook broodstock (cf. Banks et al. 1999 submitted)?	Use same samples as in Question 2.3.	Same schedule as Question 2.3.
2.2) Is the mainstem Sacramento River late-fall chinook population in genetic equilibrium? Is any disequilibrium in CNFH late-fall-run chinook observable in mainstem Sacramento River late-fall chinook (i.e. Is disequilibrium spreading from CNFH to the mainstem?)?	Sample 100 carcasses from mainstem Sacramento River in winter of 2000 (N=100) plus samples from Question 2.3.	January through March, 2000.
2.3) Does observed genetic disequilibrium vary within a spawning season? Is disequilibrium more pronounced during the early and late portions of the late-fall run?	Sample 200 adult late-fall-run returning to CNFH three times within the late-fall run in 2000 (N=600).	In 2000, sample first 200 late-fall-run that return CNFH (early January through early February; sample 200 fish during the peak late-fall run in l February; sample 200 fish from the second week of March through the third week of April.

I-018040

3) Battle Creek winter-run chinook salmon.

Objectives: Determine if there is a native winter chinook population; estimate its effective size.

Question	Sampling Protocol	Sampling Schedule
3.1) Are winter-run chinook, identified by phenotypic/run timing characteristics, genetically identifiable as winter-run (i.e. Is there a genetically identifiable winter-run chinook population in Battle Creek?)?	Examine non-clipped fish trapped at CNFH during the winter run. (N≤25?)	At CNFH fish trap, March – June, 2000.
3.2) Is there a genetically distinct Battle Creek population of winter-run distinguishable from the Sacramento River population?	Use samples as in Question 3.1 and 3.3 and archived Sacramento River winter-run samples.	Same as Question 3.1 and 3.3.
3.3) What is the effective population size of the Battle Creek population of winter-run?	Sample juveniles by screw trap (N=100)	July through December, 2000

4) Battle Creek spring-run chinook salmon.

Objectives: Determine relationship to other spring runs; assess extent of hybridization with CNFH fall; estimate effective size.

Question	Sampling Protocol	Sampling Schedule
4.1) What is the relationship of Battle Creek spring chinook to other chinook examined previously in the mainstem Sacramento River and Butte, Mill, and Deer Creeks?	Sample adults trapped at CNFH or carcasses found (N=100?) plus same samples as in Question 4.3.	April – June, 2000.
4.2) Is there a genetic difference between early and late-arriving spring-run chinook in Battle Creek (i.e. is there evidence of hybridization with fall run)?	Use same samples as in Question 4.1.	Same as Question 4.1.
4.3) What is the effective size of the Battle Creek spring run?	Sample juveniles with screw trap (N=200)	October, 1999 through April, 2000

5) Butte Creek chinook salmon. Objectives: Determine temporal distribution of fall and spring chinook runs; estimate effective size.

Question	Sampling Protocol	Sampling Schedule
5.1) Do spring and fall chinook mix in Butte Creek?	Sample 100 adults/carcasses three times during spring/fall run in 2000 (N=300).	Summer/Fall, 2000
5.2) What is the effective population size of this spring run?	Use same sample as in Question 6.1. Sample juveniles (N=200)	October, 1999 through April, 2000

6) Clear Creek chinook salmon. Objectives: Determine if there is a bona fide spring run in Clear Creek; estimate its effective size.

Question	Sampling Protocol	Sampling Schedule
6.1) Are there spring chinook in Clear Creek and are they more closely related to the Butte Creek or Mill and Deer Creek subpopulations? Do spring and fall chinook mix in Clear Creek?	Sample 100 adults/carcasses three times during the spring/fall run in 20000 (N=300).	September – October, 2000
6.2) What is the effective size of this spring-run?	Use same sample as in Question 7.1. Sample juveniles (N=200).	October, 1999 through April, 2000

Ecological/Biological Objectives

Ecological/Biological Benefits: Current, large-scale, fish habitat restoration programs that intend to allow chinook salmon access to historic habitats are a novel development in the management of Central Valley fisheries that create unique challenges and opportunities. A significant challenge to these programs will be ensuring that the recolonization of restored habitats proceeds in a manner that protects the genetic diversity of target salmonid populations. While the fisheries management and research communities have made significant advances in our understanding of the genetics of chinook salmon (e.g. Banks et al. 1996, 1999, submitted), this understanding merely scratches the surface of a complicated ecological and genetic paradigm that is quickly becoming the driver of all future conservation, restoration, and fisheries management policy and decision-making processes. To complicate matters, historical opportunities to restore fish habitat may be overtaking our limited understanding of the animals we hope to restore. Therefore, there is a great need to rapidly develop deeper insight into the genetics of the Central Valley's chinook salmon populations, and use new and existing information to forge management policies that will form the basis for salmonid management well into the 21st Century. Most importantly, this research and planning must proceed apace with the current habitat restoration and should not delay or hold back the progress made to date.

The proposed project responds to this great need for a clearer understanding of the structures of salmonid populations. The objectives of this project will be to develop a biological and genetic management plan that coordinates existing management policies with the novel conservation needs encountered in restored ecosystems of the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones. This plan will reconcile existing and new conservation genetics results with competing management priorities including the harvest needs of commercial and sport fisheries, concerns under the ESA and CESA, CALFED Strategic Goals, mitigation obligations, hatchery policies, and the needs of non-fisheries water users and conservationists. An important part of the management plan will be additional, new genetic analyses designed to improve race discrimination in chinook salmon and answer genetic concerns vital to the restoration and conservation of salmon in restored habitats.

The biological and genetic management plan that we propose to develop will encompass chinook stocks throughout the entire Northern Sacramento Valley and Butte Basin Ecosystem Management Zones (EMZs) but will focus on populations of fish in Clear, Battle, and Butte Creeks, and the upper Sacramento River. We chose to focus on these populations because: 1) significant genetic management questions concerning these populations have been raised, 2) existing genetic information about these populations allows us to go beyond mere base-line research and instead develop information robust enough to aid in management decision-making, and 3) these populations reside in habitats affected by large-scale habitat restoration programs. However, we will take the information developed for these populations and extrapolate it, where appropriate, to suggest ways to manage all anadromous salmonid stocks in these two EMZs. We reluctantly choose not to include steelhead in this proposal because we understand that CDFG is currently developing a research study of steelhead population genetics in the Central Valley and that study is slated for funding under the Anadromous Fisheries Restoration Program. Furthermore, CALFED has recently funded at least two projects to study the genetics of steelhead.

Hypotheses: The genetic research portion of this project will seek to answer several questions important to the management and restoration of chinook salmon. Specific scientific questions are listed in Table 2. These specific questions can be used to answer important fisheries management questions that have recently surfaced.

For instance, in Battle Creek concerns regarding suspected genetic hybridization between spring-, fall-, and late-fall-run chinook have been expressed (CDFG 1993b, 1998b; Banks et al. 1999; Ward and Kier 1999a). Such concerns have impacted the operation of hatchery facilities including the barrier dam at CNFH (USBR 1998) and could impact salmon restoration in Battle Creek. In fact, genetic concerns have prompted suggestions that a genetically-based management plan be developed for the operation of the Coleman National Fish Hatchery (CNFH) barrier weir and fish ladder (Ward and Kier 1999b). The proposed project will investigate potential hybridization of Battle Creek fall-run chinook by asking whether: 1) previously observed disequilibrium persists in the population, 2) genetic disequilibrium varies by season within the fall-run population, and 3) are fall-run hybridizing with spring-run (as evidenced by greater genetic disequilibrium early in the fall run) and/or are fall-run hybridizing with late-fall-run (as evidenced by greater genetic disequilibrium late in the fall run)?

Another example of the fisheries management questions that our research will answer is the question: are chinook which have entered Sacramento River tributaries in September of recent years spring-run or fall-run chinook salmon? To answer these questions, we will perform detailed genetic investigations of the over-lap of spring-run and fall-run populations in Battle, Butte, and Clear creeks. The answer to this question will then be related to hypotheses that run-timing is being influenced by current habitat conditions in the Sacramento River and tributaries.

Benefits: The primary benefits of the proposed project will be: 1) an advanced understanding of the genetics of salmon populations, 2) a management plan that will lead to improved ways to conserve dwindling fish stocks, including several listed under state and federal ESAs, 3) a management plan with improved methods for minimizing impacts of fish-protection measures on sport and commercial fisheries and water-users, 4) a management plan that will integrate existing mitigation obligations and hatchery policies with Sacramento River fisheries management, and 5) a management plan that will create an adaptive-management framework for the recolonization of habitats that are, or soon will be, under restoration.

A final, primary benefit of our proposed project will be the protection of several hundred million dollars of fish habitat restoration programs. Changes in the genetic population structure of existing fish populations, not to mention the loss of unique salmonid stocks, threatens the success of current and future restoration programs. Stakeholders are increasingly frustrated that huge expenditures for habitat restoration may be lost if stocks disappear or continue to dwindle due to genetic changes in population structure (Joseph 1998). Considering that more than $326 million[1] will be spent to achieve a restored target of 126,000 salmonids in the mainstem Sacramento River, $27 million of public funds to restore fish populations to Battle Creek, and about $30 million spent on recent upgrades to CNFH plus an annual operational cost of about $2 million to ensure a return of 30,000 spawning salmonids, it is critical that known genetic issues be systematically addressed by the research and planning proposed in this project.

Durability: The understanding of fish population structure and the genetic management plan will be long-lasting. That is not to say that new research or updated management plans will not be created. However, the proposed research is comprehensive, and will provide a lasting foundation for management, as well as future research. The biological and genetic management plan that we propose will be the first of its kind to integrate cutting-edge genetic research with the whole range of conflicting stakeholder and agency needs. The legacy of this plan will last for decades as it will include prescriptions set in an adaptive management framework designed to accommodate future, emerging information.

[1] The total of $326 million is based on estimates of $80 million for the Shasta Temperature Control Device, $10 million for improvements to the ACID diversion dam, $3 million for modifications to the Keswick Fish Trap and stilling basin, $150 million for restoration of Iron Mountain Mine (which could eventually reach as high as $300 million), $75 million for fixes at Red Bluff Diversion Dam, and $8 million for restoration of Clear Creek (Ward and Kier 1999b).

Linkages: This project is linked to three existing genetic research projects being conducted by Dr. Hedgecock of the University of California, Davis. There is no overlap between existing projects and the proposed CALFED project, with respect to the samples being analyzed. We propose new genetic research not being carried out under any existing or pending contract. At the same time, the proposed work will be integrated into and coordinated with other projects, taking full advantage of common methodologies and growing database resources. We anticipate that the net effect on lab space and lab personnel at BML will remain more or less at a steady level, as existing projects expire.

In addition to genetic research conducted by University of California, Davis, several related and complementary projects are currently underway. We understand that CDFG is currently developing a research study of steelhead population genetics in the Central Valley and that this study is slated for funding under the Anadromous Fisheries Restoration Program. CALFED has funded Project Number 98-F1005 to study the stock composition of steelhead in the Yuba River, Project Number 98-F1001 to study genetics of steelhead in Clear Creek, and the 1997 Restoration Coordination project I121 to develop a genetic baseline for salmon in the San Joaquin River. These complementary studies leave open the need for definitive research and planning for chinook salmon stocks in the North Sacramento Valley and Butte Basin EMZs.

This proposal was written in response to a "Focused Action" on page 28 of the Proposal Solicitation Package. It addresses several ERP actions and goals. For instance, this project will assist the recovery of "at-risk" salmon species by developing a plan that considers unique genetic characteristics of various populations (ERP Vol. II, page 1; Strategic Plan, Goal 1, pages 28 – 30). Likewise, this project will protect biodiversity and allow for restoration of the "natural biotic community" by genetically identifying, and resolving the management of, individual stocks of chinook salmon that could otherwise be lost or overlooked (Strategic Plan, Goal 2, pages 28 – 30). This project will also foster the maintenance and enhancement of populations of salmon for commercial and recreational harvest by specifically including representatives of these two stakeholder groups in the development of the management plan for chinook salmon (ERP Vol. II, page 1; Strategic Plan, Goal 3, pages 29 – 30). This project will revise extinction models for sensitive chinook stocks which will help achieve the target of ensuring the continued existence of winter-run chinook (ERP Vol. II page 26). Finally, this project will help the goal of restoring spring-run chinook by investigating the "introgression with fall-run" that is cited as a factor affecting the status of these fish (ERP Vol. II, page 27).

Systemwide Ecosystem Benefits

Restoration programs on Battle, Butte, and Clear creeks, as well as the Sacramento River, will benefit from this project. For example, current operation of the CNFH barrier dam has the potential to impede restoration of some stocks of chinook salmon to habitat in the mid-reaches of Battle Creek (Ward and Kier 1999b). A better understanding of the complexity of population structure in Battle Creek will likely assist the management of this weir and provide managers of CNFH with more certainty regarding broodstock selection and weir operations.

Compatibility with Non-Ecosystem Objectives

This project has the potential to provide significant benefits for water users within the Sacramento River watershed. As our understanding of stock structure becomes fine-tuned through further genetic research, the ability to more closely manage the operations of water diversions becomes more possible. This project will be improving upon the methods of mixed stock analysis that has been developed for CDWR in the Delta and will likely provide more tools to resolve fish and water-use conflicts that can be applied throughout the Bay-Delta watershed.

Technical Feasibility and Timing

Three alternatives to our proposed development of a biological and genetic management plan for chinook salmon in the Central Valley were considered and rejected. First, we considered developing the management plan without collecting additional genetic information. However, this alternative was rejected because the current understanding of the genetics of Central Valley salmonids is in its infancy and reliance on previous research would be insufficient for making substantive management policy. Furthermore, we acknowledge that the link between population genetics and ecological restoration is quickly forming a new management paradigm that will direct all future conservation, restoration, and fisheries decision-making processes. Development of this paradigm demands greater understanding.

The second alternative that we considered was including the entire Central Valley as part of this management planning process. Although we recognize that genetic management planning is needed for other parts of the Central Valley, this alternative was reluctantly rejected due to cost considerations inherent in this much larger alternative. Also, scientific knowledge of the genetics of San Joaquin River salmonid stocks is too preliminary at this time despite strong efforts to improve this situation (e.g. the 1997 Restoration Coordination Project I121 will develop a genetic baseline for salmon in the San Joaquin River, but this baseline will not be as detailed as the analyses that we propose to conduct in the upper Sacramento River EMZs and propose to use for management planning).

The third alternative was even harder to set aside, and, in fact, may be reconsidered at a later date. We originally had hoped to include steelhead genetic research in this proposal. However, this effort would have been too broad. Furthermore, a study to be conducted by CDFG's Steelhead Trout Program is currently slated for funding by the AFRP but will likely have a completion date later than that contemplated for this study. Kier Associates will be negotiating with CDFG to possibly use the results of their steelhead genetic study in developing a genetic management policy for steelhead in conjunction with the proposed planning process. These discussions are too preliminary at this time to commit to any changes in our proposed Scope of Work. Any additional planning assistance we could provide would be funded under separate sources than this proposal and would require a separate contract. Finally, the work contemplated in this proposal would be in no way negatively affected should these separate negotiations prove to be unproductive.

Scientific collecting permits and CESA MOUs are required for sampling and possessing of salmonid tissues. CDFG is responsible for authorizing all tissue collections. In this proposal, salmonid tissues in the upper river will be collected by CDFG, USFWS, and Kier Associates or qualified subcontractors, in conjunction with existing CDFG/USFWS sampling programs. These agencies will obtain the necessary permits and MOUs. UCD-BML has existing CESA MOUs to possess some genetic tissue but may have to modify its CESA MOU in order to possess some of the samples proposed in this study. Modifications to UCD-BML's CESA MOU will be pursued immediately upon contract initiation.

Monitoring and Data Collection Methodology

Ecological/Biological Objectives: The overarching research questions to support the stated objectives are in Table 3 and the intermediate, detailed research questions are in Table 2.

Monitoring Parameters and Data Collection Approach: The data collection approach to answer the overarching and intermediate research questions will be as follows: Tissue samples, a small clipped portion of the caudal fin, will be taken from chinook salmon in the mainstem Sacramento River and in Battle, Butte, and Clear Creeks, and at Coleman National Fish Hatchery (CNFH) in accordance with sample sizes detailed in Table 2. Fish to be sampled will include live adults and juveniles, and adult carcasses. Fish will be captured by standard methods and live fish will be returned, unharmed, to the stream after samples are obtained. These samples will be typed for microsatellite DNA markers, as described by Banks et al. (1999 and submitted).

Data Evaluation Approach: The steps in such analyses include DNA extraction, DNA amplification and genetic typing of individuals, and separation and scoring of DNA markers. DNA will be extracted and amplified using standard methods. Banks et al. (1999) describe methods and primers for enzymatic amplification of 10 microsatellite DNA markers from chinook salmon by the polymerase chain reaction (PCR). UCD-BML has characterized the frequencies of different forms of these markers in 41 baseline populations of chinook in the Central Valley (Banks et al., submitted). In addition to these markers, UCD-BML has recently cloned five more microsatellite markers from spring chinook that show promise for improving the diagnosis of individual spring chinook. We will type 5-10 informative markers on each fish.

A variety of population genetic analyses will be done with individual genotype data, as required by the particular problem (see Table 2) and using available software (see Banks et al. submitted). For adult populations, we will first determine whether the observed numbers and kinds of genotypes conform to those expected if there is random mating among individuals. We have previously confirmed this expectation for wild salmon populations, as have many others before us for salmon in general, but we have also recorded exceptions among Central Valley chinook populations. The disequilibrium observed in stocks propagated at the CNFH (winter, Hedgecock et al. in prep.; fall and late-fall, Banks et al., submitted) is particularly troublesome. Admixture and hybridization are the simplest explanations for these departures from expected random mating equilibria. Hybridization could have serious implications for the recovery of protected stocks. We will perform mixed stock analyses (MSA) to determine whether the observed disequilibria can be attributed to mixture of stocks during trapping. We will examine the temporal pattern of disequilibria to test the hypothesis that overlap in run timing leads to mixture in hatchery broodstocks. We will try to determine whether hybridization has actually occurred.

For stocks like spring-run in many parts of its range or winter chinook on Battle Creek, it is difficult to sample adults for genetic analysis. For instance, the number of winter chinook in Battle Creek may be very small and we expect a sample size of these fish to be less than 25 fish. In these cases we will rely more heavily on sampling juveniles. Samples of juveniles present challenging problems for geneticists, because they are non-random samples of the local gene pool, potentially containing full- or half-brothers and sisters. On one hand, progeny from a reproducing population contain information on the number of breeders, an important parameter we wish to estimate for genetic management. Estimating effective population size from such data is a major research interest of the Hedgecock laboratory (Pudovkin et al. 1996). On the other hand, if one wishes to infer something about the stock, e.g. its relatedness to a stock from another watershed, it is necessary to correct first for the relatedness of individuals within the sample. We have already tackled this issue for spring chinook (Banks et al. submitted).

Table 3. Overarching research questions to support the stated objectives.

1)	Battle Creek fall-run chinook salmon:
	What is the genetic integrity of this run?
	How does this run overlap with other runs?
	What are the causes of disequilibrium observed in this run?
	How can the risk of artificial hybridization be reduced?.
2)	Battle Creek late-fall-run chinook salmon:
	What is the genetic integrity of this run?
	What are the causes of disequilibrium observed in this run?
	How can the risk of artificial hybridization be reduced?.
3)	Battle Creek winter-run chinook salmon:
	Does a native winter-run chinook population exist in Battle Creek?
	If so, what is its effective population size?
4)	Battle Creek spring-run chinook salmon:
	What is the relationship between this population and other spring runs?
	What is the extent of hybridization with CNFH fall-run chinook?
	What is the effective size of this population?
5)	Butte Creek chinook salmon:
	What are the temporal distributions of the fall and spring chinook runs?
	What is the effective population size of the spring run?
6)	Clear Creek chinook salmon:
	What are the temporal distributions of the fall and spring chinook runs?
	What is the effective population size of the spring run?

Local Involvement

Organizations/agencies that are aware of this proposal and have shown interest include: California Department of Fish and Game, U.S. Fish and Wildlife Service, California Department of Water Resources, U.S. Bureau of Reclamation, National Marine Fisheries Service, the Battle Creek Working Group, Battle Creek Watershed Conservancy, and the Pacific Coast Federation of Fishermen's Associations. No organizations have expressed opposition to this project, and, because it involves only data collection, analysis, and management planning in an open process, it is anticipated that there will be no opposition to the proposal. No third part impacts are anticipated.

Outreach to any agency or organization who may be affected by the process will be conducted during the selection of an advisory committee. In fact, we intend to include all interested and affected parties in the advisory process throughout the project.

April 15, 1999

The Honorable Ross Turner
Chair and Members
Tehama County Board of Supervisors
PO Box 205
Red Bluff, CA 96080

Dear Supervisors

This is to advise you that Kier Associates, northern California consultants in fisheries conservation and restoration have submitted to the CalFed Bay-Delta Program a project proposal, *Development of a Biological and Genetic Management Plan for Chinook Salmon in the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones*. The project is designed, in part, to guide the successful restoration of salmon and steelhead in the Battle Creek watershed. Our proposal has been prepared in close consultation with the Red Bluff office of the U.S. Fish & Wildlife Service and the Redding and Red Bluff offices of the California Department of Fish & Game.

If you wish us to communicate progress on the project, following our selection for funding by the CalFed Program, please advise us who on your staff we should contact and we will be pleased to do so.

Sincerely,

Bill Kier

Cc: Director
County of Tehama
Department of Planning

William M. Kier Associates

207 Second Street, Suite B Sausalito, CA 94965 (415) 331-4505 fax 332-8799

April 15, 1999

The Honorable Glenn Hawes
Chair and Members
Shasta County Board of Supervisors
1815 Yuba Streeet
Redding, CA 96001

Dear Supervisors

This is to advise you that Kier Associates, northern California consultants in fisheries conservation and restoration have submitted to the CalFed Bay-Delta Program a project proposal, *Development of a Biological and Genetic Management Plan for Chinook Salmon in the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones*. The project is designed, in part, to guide the successful restoration of salmon and steelhead in the Battle Creek watershed. Our proposal has been prepared in close consultation with the Red Bluff office of the U.S. Fish & Wildlife Service and the Redding and Red Bluff offices of the California Department of Fish & Game.

If you wish us to communicate progress on the project, following our selection for funding by the CalFed Program, please advise us who on your staff we should contact and we will be pleased to do so.

Sincerely,

Bill Kier

Director
Department of Planning
County of Shasta

William M. Kier Associates

207 Second Street, Suite B *Sausalito, CA 94965* *(415) 331-4505 fax 332-8799*

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April 15, 1999

Delta Protection Commission
PO Box 530
Walnut Grove, CA 95690

Dear Delta Protection Commission

This is to advise you that Kier Associates, northern California consultants in fisheries conservation and restoration have submitted to the CalFed Bay-Delta Program a project proposal, *Development of a Biological and Genetic Management Plan for Chinook Salmon in the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones*. The project is designed, in part, to guide the successful restoration of salmon and steelhead in the Battle Creek watershed. Our proposal has been prepared in close consultation with the Red Bluff office of the U.S. Fish & Wildlife Service and the Redding, Red Bluff and Sacramento headquarters offices of the California Department of Fish & Game, as well as the Santa Rosa offices of the National Marine Fisheries Service.

If you wish us to communicate progress on the project, following our selection for funding by the CalFed Program, please advise us who on your staff we should contact and we will be pleased to do so.

Sincerely,

Bill Kier

William M. Kier Associates

207 Second Street, Suite B Sausalito, CA 94965 (415) 331-4505 fax 332-8799

April 15, 1999

Bay Conservation and Development Commission
30 Van Ness Avenue, Room 2011
San Francisco, CA 94102

Dear Bay Conservation and Development Commission

This is to advise you that Kier Associates, northern California consultants in fisheries conservation and restoration have submitted to the CalFed Bay-Delta Program a project proposal, *Development of a Biological and Genetic Management Plan for Chinook Salmon in the Northern Sacramento Valley and Butte Basin Ecosystem Management Zones*. The project is designed, in part, to guide the successful restoration of salmon and steelhead in the Battle Creek watershed. Our proposal has been prepared in close consultation with the Red Bluff office of the U.S. Fish & Wildlife Service and the Redding, Red Bluff and Sacramento headquarters offices of the California Department of Fish & Game, as well as the Santa Rosa offices of the National Marine Fisheries Service.

If you wish us to communicate progress on the project, following our selection for funding by the CalFed Program, please advise us who on your staff we should contact and we will be pleased to do so.

Sincerely,

Bill Kier

William M. Kier Associates

207 Second Street, Suite B Sausalito, CA 94965 (415) 331-4505 fax 332-8799

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Cost

Budget: CALFED funds are needed primarily to pay for the development of the management plan and for genetic research. The majority of sampling of DNA from 3600 chinook salmon will be performed by CDFG and USFWS during several ongoing fish monitoring projects and will be funded through existing projects. The proposed budget includes $24,026 so Kier Associates can furnish labor to assist CDFG/USFWS obtain sample sizes in Battle Creek and Clear Creek that are larger than samples routinely collected. The handling and archiving of DNA samples will be performed and funded by CDFG.

Table 4. Total budget for project.

Task	Direct Labor (hours)	Direct Salary and Benefits	Service Contracts	Material and Acquisition Costs	Misc. and other Direct Costs	Overhead and Indirect Costs	Total Costs
Task 1 – Gen. Cons. Adv. Team	410	$28,154	$0	$0	$6,375	$1,275	$35,804
Task 2 – Gen. Cons. and Pol. Res.	495	$29,940	$0	$0	$6,325	$1,265	$37,530
Task 3 – Sampling	355	$20,945	$0	$0	$2,567	$513	$24,026
Task 4 – DNA Analysis	0	$0	$144,525	$0	$0	$28,905	$173,430
Task 5– Pop. Analysis and Rept.	0	$0	$25,504	$0	$0	$5,101	$30,605
Task 6 – Mgt. Plan Preparation	1,415	$88,525	$0	$0	$20,550	$4,110	$113,185
Task 7 – Project Management	840	$59,640	$0	$0	$6,725	$1,345	$67,710
Total	3,515	$227,204	$170,029	$0	$42,542	$42,514	$482,289
Note: Overhead and Indirect Costs = 20% of service contracts, materials, misc., and ODC.							

Table 5. Quarterly project budget*.

Task	Oct - Dec 99	Jan - Mar 00	Apr – Jun 00	Jul - Sep 00	Oct - Dec 00	Jan - Mar 01	Apr - Jun 01	Jul - Sep 01	Total
Task 1 – Gen. Cons. Adv. Team	$7,161	$7,161	$0	$7,161	$0	$0	$7,161	$7,161	$35,804
Task 2 – Gen. Cons. & Pol. Res.	$32,169	$5,361	$0	$0	$0	$0	$0	$0	$37,530
Task 3 – Sampling	$3,003	$3,003	$3,003	$3,003	$3,003	$3,003	$3,003	$3,003	$24,026
Task 4 – DNA Analysis	$0	$40,022	$40,022	$40,022	$40,022	$13,341	$0	$0	$173,430
Task 5– Pop. Anal. and Rept.	$0	$6,121	$6,121	$6,121	$6,121	$6,121	$0	$0	$30,605
Task 6 – Mgt. Plan Preparation	$0	$16,169	$16,169	$16,169	$16,169	$16,169	$16,169	$16,169	$113,185
Task 7 – Project Management	$8,464	$8,464	$8,464	$8,464	$8,464	$8,464	$8,464	$8,464	$67,710
Total	$50,796	$86,302	$73,779	$80,940	$73,779	$47,098	$34,797	$34,797	$482,289

- Budget dates assume a 10/1/99 project initiation upon completion of final contract.

Schedule: Please refer to Table 1 for start and completion dates and project milestones. All costs and expenses will be billed monthly regardless of project milestones. However, completion dates for all milestones would likely be contractually obliged. Incremental funding or implementation of this work is not feasible.

Cost-Sharing

The majority of DNA sampling from approximately 3600 chinook salmon will be funded by CDFG and USFWS as part of several ongoing fish monitoring projects. Furthermore, CDFG will fund the archiving and handling of genetic samples. At this point, there are no other funding commitments for this project.

Literature Cited

Banks, M. A., B. A. Baldwin, and D. Hedgecock. 1996. Research on chinook salmon (*Oncorhynchus tshawytscha*) stock structure using microsatellite DNA. Bulletin of National Research Institute of Aquaculture, Supplement 2:5-9.

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Ward, M.B. and W.M. Kier. 1999a. Battle Creek salmon and steelhead restoration plan. Prepared for the Battle Creek Working Group by Kier Associates under contract with Metropolitan Water District of Southern California. Sausalito, Ca. 142 pp.

Ward, M.B. and W.M. Kier. 1999b. Draft: Maximizing compatibility between Coleman National Fish Hatchery operations, management of lower Battle Creek, and salmon and steelhead restoration. Prepared for the Battle Creek Working Group by Kier Associates under contract with Metropolitan Water District of Southern California. Sausalito, Ca. 142 pp.

Applicant Qualifications

This project will be undertaken by a joint effort between Kier Associates and the University of California, Davis. The principle investigators for this project include William Kier and Michael Ward, from Kier Associates, and Dr. Dennis Hedgecock from the University of California, Davis. Mr. Kier will manage the overall project, will coordinate the Genetic Conservation Advisory Team, and will offer his broad experience in natural resource planning. Mr. Ward will be responsible for policy research and plan preparation. Dr. Hedgecock will supervise the laboratory work and data analyses. He will also serve as the liaison to Kier Associates, in order to integrate genetic information into the management plan. CDFG and USFWS will be collecting genetic samples and CDFG will handle and archive those samples.

Kier Associates specializes in the development and implementation of salmon population and salmonid habitat conservation and restoration plans, primarily for State and federal government agencies. In addition to restoration programs developed for the Klamath River basin and Garcia River watershed, the Kier Associates has recently completed the ***Battle Creek Salmon and Steelhead Restoration Plan*** and the companion draft ***Maximizing Compatibility Between Coleman National Fish Hatchery Operations, Management of Lower Battle Creek, and Salmon and Steelhead Restoration***.

William Kier, a certified fisheries scientist, has four decades of experience in natural resources project planning and management in California and the Pacific Northwest. In addition to his lead role in the above mentioned planning projects on Battle Creek, Mr. Kier has recently served as principal consultant to the California Advisory Committee on Salmon and Steelhead, conducted a review of water quality and habitat monitoring programs on private timberlands for the California Department of Fish and Game, and has developed the KRIS resource information system to support salmon restoration programs in the Klamath, Trinity, Battle Creek, and Humboldt County watersheds.

Michael Ward is a fisheries ecologist who specializes in the applied research and management of salmon and steelhead. Mr. Ward brings to this project over 12 years of experience investigating relationships between Pacific salmon populations and their habitat, as well as a broad perspective of salmon population structure from populations ranging from California to Alaska. Mr. Ward was the primary author of Kier Associates' two recent planning documents for Battle Creek and lead technical efforts to support that work.

Dr. Dennis Hedgecock has been conducting genetic research for 25 years at the Bodega Marine Laboratory and has written over 80 research papers on a wide range of genetic topics. He has been a principal geneticist at BML since 1990. In recent years, Dr. Hedgecock has pioneered studies of the genetic structure of chinook salmon populations in the Central Valley including studies of captive breeding and broodstock selection in winter-run chinook, development of genetic markers in spring-run chinook, and development of mixed stock analysis of salmon in the Sacramento-San Joaquin Delta.

STATE OF CALIFORNIA

NONDISCRIMINATION COMPLIANCE STATEMENT

STD. 19 (REV. 3-95) FMC

COMPANY NAME

Kier Associates

The company named above (hereinafter referred to as "prospective contractor") hereby certifies, unless specifically exempted, compliance with Government Code Section 12990 (a-f) and California Code of Regulations, Title 2, Division 4, Chapter 5 in matters relating to reporting requirements and the development, implementation and maintenance of a Nondiscrimination Program. Prospective contractor agrees not to unlawfully discriminate, harass or allow harassment against any employee or applicant for employment because of sex, race, color, ancestry, religious creed, national origin, disability (including HIV and AIDS), medical condition (cancer), age, marital status, denial of family and medical care leave and denial of pregnancy disability leave.

CERTIFICATION

I, the official named below, hereby swear that I am duly authorized to legally bind the prospective contractor to the above described certification. I am fully aware that this certification, executed on the date and in the county below, is made under penalty of perjury under the laws of the State of California.

OFFICIAL'S NAME

William Kier, Principal, Kier Associates

DATE EXECUTED

April 14, 1999

EXECUTED IN THE COUNTY OF

Marin

PROSPECTIVE CONTRACTOR'S SIGNATURE

William M. Kier

PROSPECTIVE CONTRACTOR'S TITLE

Principal

PROSPECTIVE CONTRACTOR'S LEGAL BUSINESS NAME

Kier Associates

I-018055

PART C: Certification Regarding Drug-Free Workplace Requirements

CHECK X IF THIS CERTIFICATION IS FOR AN APPLICANT WHO IS NOT AN INDIVIDUAL.

Alternate I. (Grantees Other Than Individuals)

A. The grantee certifies that it will or continue to provide a drug-free workplace by:

(a) Publishing a statement notifying employees that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the grantee's workplace and specifying the actions that will be taken against employees for violation of such prohibition;

(b) Establishing an ongoing drug-free awareness program to inform employees about–
(1) The dangers of drug abuse in the workplace;
(2) The grantee's policy of maintaining a drug-free workplace;
(3) Any available drug counseling, rehabilitation, and employee assistance programs; and
(4) The penalties that may be imposed upon employees for drug abuse violations occurring in the workplace;

(c) Making it a requirement that each employee to be engaged in the performance of the grant be given a copy of the statement required by paragraph (a);

(d) Notifying the employee in the statement required by paragraph (a) that, as a condition of employment under the grant, the employee will –
(1) Abide by the terms of the statement; and
(2) Notify the employer in writing of his or her conviction for a violation of a criminal drug statute occurring in the workplace no later than five calendar days after such conviction;

(e) Notifying the agency in writing, within ten calendar days after receiving notice under subparagraph (d)(2) from an employee or otherwise receiving actual notice of such conviction. Employers of convicted employees must provide notice, including position title, to every grant officer on whose grant activity the convicted employee was working, unless the Federal agency has designated a central point for the receipt of such notices. Notice shall include the identification number(s) of each affected grant;

(f) Taking one of the following actions, within 30 calendar days of receiving notice under subparagraph (d)(2), with respect to any employee who is so convicted –
(1) Taking appropriate personnel action against such an employee, up to and including termination, consistent with the requirements of the Rehabilitation Act of 1973, as amended; or
(2) Requiring such employee to participate satisfactorily in a drug abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency;

(g) Making a good faith effort to continue to maintain a drug-free workplace through implementation of paragraphs (a), (b), (c), (d), (e) and (f).

B. The grantee may insert in the space provided below the site(s) for the performance of work done in connection with the specific grant:

Place of Performance (Street address, city, county, state, zip code)

207 Second St, Ste B
Sausalito, CA 94965

Check X if there are workplaces on file that are not identified here.

PART D: Certification Regarding Drug-Free Workplace Requirements

CHECK __ IF THIS CERTIFICATION IS FOR AN APPLICANT WHO IS AN INDIVIDUAL.

Alternate II. (Grantees Who Are Individuals)

(a) The grantee certifies that, as a condition of the grant, he or she will not engage in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance in conducting any activity with the grant;

(b) If convicted of a criminal drug offense resulting from a violation occurring during the conduct of any grant activity, he or she will report the conviction, in writing, within 10 calendar days of the conviction, to the grant officer or other designee, unless the Federal agency designates a central point for the receipt of such notices. When notice is made to such a central point, it shall include the identification number(s) of each affected grant.

PART E: Certification Regarding Lobbying
Certification for Contracts, Grants, Loans, and Cooperative Agreements

CHECK__ IF CERTIFICATION IS FOR THE AWARD OF ANY OF THE FOLLOWING AND THE AMOUNT EXCEEDS $100,000: A FEDERAL GRANT OR COOPERATIVE AGREEMENT; SUBCONTRACT, OR SUBGRANT UNDER THE GRANT OR COOPERATIVE AGREEMENT.

CHECK__ IF CERTIFICATION IS FOR THE AWARD OF A FEDERAL LOAN EXCEEDING THE AMOUNT OF $150,000, OR A SUBGRANT OR SUBCONTRACT EXCEEDING $100,000, UNDER THE LOAN.

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, and officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

As the authorized certifying official, I hereby certify that the above specified certifications are true.

SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL: William M. Kier

TYPED NAME AND TITLE: William M. Kier, Principal

DATE: April 14, 1999

I-018057

APPLICATION FOR FEDERAL ASSISTANCE

OMB Approval No. 0348-0043

2. DATE SUBMITTED	Applicant Identifier
4/15/99	N/A

1. TYPE OF SUBMISSION:		3. DATE RECEIVED BY STATE	State Application Identifier
Application	Preapplication	N/A	N/A
☐ Construction	☐ Construction	4. DATE RECEIVED BY FEDERAL AGENCY	Federal Identifier
☒ Non-Construction	☐ Non-Construction		

5. APPLICANT INFORMATION

Legal Name:	Organizational Unit:
Kier Associates	For-Profit Business
Address *(give city, county, State, and zip code):*	Name and telephone number of person to be contacted on matters involving this application *(give area code)*
207 Second St., Ste. B Sausalito, CA 94965	Bill Kier 415/331-4505

6. EMPLOYER IDENTIFICATION NUMBER *(EIN):* 68-0164260

7. TYPE OF APPLICANT: *(enter appropriate letter in box)* ☐

A. State — H. Independent School Dist.
B. County — I. State Controlled Institution of Higher Learning
C. Municipal — J. Private University
D. Township — K. Indian Tribe
E. Interstate — L. Individual
F. Intermunicipal — M. Profit Organization
G. Special District — N. Other (Specify) ~~Private/Univ~~ jt ven

8. TYPE OF APPLICATION:

☒ New ☐ Continuation ☐ Revision

If Revision, enter appropriate letter(s) in box(es) ☐ ☐

A. Increase Award B. Decrease Award C. Increase Duration
D. Decrease Duration Other *(specify):*

9. NAME OF FEDERAL AGENCY:

10. CATALOG OF FEDERAL DOMESTIC ASSISTANCE NUMBER: ☐☐–☐☐☐

TITLE: N/A

11. DESCRIPTIVE TITLE OF APPLICANT'S PROJECT:

Developing a Biologicaland genetic Management Plan for Chinook Salmon in the Northern Sacramento Valley and Butte Basin Ecosystem Mgt. Zones

12. AREAS AFFECTED BY PROJECT *(Cities, Counties, States, etc.):*

Tehama and Shasta counties

13. PROPOSED PROJECT		14. CONGRESSIONAL DISTRICTS OF:	
Start Date	Ending Date	a. Applicant	b. Project
10/99	9/01	Kier Associates/UC-Davis	Salmon Genetics Plan

CA Districts 2 and 3

15. ESTIMATED FUNDING:

a. Federal	$ 482,289.00
b. Applicant	$ .00
c. State	$ .00
d. Local	$ .00
e. Other	$ .00
f. Program Income	$ .00
g. TOTAL	$ .00

16. IS APPLICATION SUBJECT TO REVIEW BY STATE EXECUTIVE ORDER 12372 PROCESS?

a. YES. THIS PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON:

DATE _____

b. No. ☐ PROGRAM IS NOT COVERED BY E. O. 12372
☐ OR PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW

17. IS THE APPLICANT DELINQUENT ON ANY FEDERAL DEBT?

☐ Yes If "Yes," attach an explanation. ☒ No

18. TO THE BEST OF MY KNOWLEDGE AND BELIEF, ALL DATA IN THIS APPLICATION/PREAPPLICATION ARE TRUE AND CORRECT, THE DOCUMENT HAS BEEN DULY AUTHORIZED BY THE GOVERNING BODY OF THE APPLICANT AND THE APPLICANT WILL COMPLY WITH THE ATTACHED ASSURANCES IF THE ASSISTANCE IS AWARDED.

a. Type Name of Authorized Representative	b. Title	c. Telephone Number
Bill Kier	Principal	415/331-4505
d. Signature of Authorized Representative		**e. Date Signed**
William M Kier		4/15/99

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Prescribed by OMB Circular A-102

I –018058

I-018058

OMB Approval No. 0348-0044

BUDGET INFORMATION - Non-Construction Programs

SECTION A - BUDGET SUMMARY

Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Estimated Unobligated Funds		New or Revised Budget		
		Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1.		$	$	$	$	$
2.						
3.						
4.						
5. Totals		$	$	$	$	$

SECTION B - BUDGET CATEGORIES

6. Object Class Categories	GRANT PROGRAM, FUNCTION OR ACTIVITY (1)	(2)	(3)	(4)	Total (5)
a. Personnel	$	$	$	$	$
b. Fringe Benefits					
c. Travel					
d. Equipment					
e. Supplies					
f. Contractual					
g. Construction					
h. Other					
i. Total Direct Charges (sum of 6a-6h)					
j. Indirect Charges					
k. TOTALS (sum of 6i and 6j)	$	$	$	$	$
7. Program Income	$	$	$	$	$

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I—018059

I-018059

SECTION C - NON-FEDERAL RESOURCES				
(a) Grant Program	(b) Applicant	(c) State	(d) Other Sources	(e) TOTALS
8.	$	$	$	$
9.				
10.				
11.				
12. TOTAL (sum of lines 8 - 11)	$	$	$	$

SECTION D - FORCASTED CASH NEEDS					
	Total for 1st Year	1st Quarter	2nd Quarter	3rd Quarter	4th Quarter
13. Federal	$	$	$	$	$
14. NonFederal					
15. TOTAL (sum of lines 13 and 14)					

SECTION E - BUDGET ESTIMATES OF FEDERAL FUNDS NEEDED FOR BALANCE OF THE PROJECT				
(a) Grant Program	FUTURE FUNDING PERIODS (Years)			
	(b) First	(c) Second	(d) Third	(e) Fourth
16.	$	$	$	$
17.				
18.				
19.				
20. TOTAL (sum of lines 16-19)	$	$	$	$

SECTION F - OTHER BUDGET INFORMATION	
21. Direct Charges:	22. Indirect Charges:
23. Remarks:	

I-018060

9. Will comply, as applicable, with the provisions of the Davis-Bacon Act (40 U.S.C. §§276a to 276a-7), the Copeland Act (40 U.S.C. §276c and 18 U.S.C. §874), and the Contract Work Hours and Safety Standards Act (40 U.S.C. §§327-333), regarding labor standards for federally-assisted construction subagreements.

10. Will comply, if applicable, with flood insurance purchase requirements of Section 102(a) of the Flood Disaster Protection Act of 1973 (P.L. 93-234) which requires recipients in a special flood hazard area to participate in the program and to purchase flood insurance if the total cost of insurable construction and acquisition is $10,000 or more.

11. Will comply with environmental standards which may be prescribed pursuant to the following: (a) institution of environmental quality control measures under the National Environmental Policy Act of 1969 (P.L. 91-190) and Executive Order (EO) 11514; (b) notification of violating facilities pursuant to EO 11738; (c) protection of wetlands pursuant to EO 11990; (d) evaluation of flood hazards in floodplains in accordance with EO 11988; (e) assurance of project consistency with the approved State management program developed under the Coastal Zone Management Act of 1972 (16 U.S.C. §§1451 et seq.); (f) conformity of Federal actions to State (Clean Air) Implementation Plans under Section 176(c) of the Clean Air Act of 1955, as amended (42 U.S.C. §§7401 et seq.); (g) protection of underground sources of drinking water under the Safe Drinking Water Act of 1974, as amended (P.L. 93-523); and, (h) protection of endangered species under the Endangered Species Act of 1973, as amended (P.L. 93-205).

12. Will comply with the Wild and Scenic Rivers Act of 1968 (16 U.S.C. §§1271 et seq.) related to protecting components or potential components of the national wild and scenic rivers system.

13. Will assist the awarding agency in assuring compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (16 U.S.C. §470), EO 11593 (identification and protection of historic properties), and the Archaeological and Historic Preservation Act of 1974 (16 U.S.C. §§469a-1 et seq.).

14. Will comply with P.L. 93-348 regarding the protection of human subjects involved in research, development, and related activities supported by this award of assistance.

15. Will comply with the Laboratory Animal Welfare Act of 1966 (P.L. 89-544, as amended, 7 U.S.C. §§2131 et seq.) pertaining to the care, handling, and treatment of warm blooded animals held for research, teaching, or other activities supported by this award of assistance.

16. Will comply with the Lead-Based Paint Poisoning Prevention Act (42 U.S.C. §§4801 et seq.) which prohibits the use of lead-based paint in construction or rehabilitation of residence structures.

17. Will cause to be performed the required financial and compliance audits in accordance with the Single Audit Act Amendments of 1996 and OMB Circular No. A-133, "Audits of States, Local Governments, and Non-Profit Organizations."

18. Will comply with all applicable requirements of all other Federal laws, executive orders, regulations, and policies governing this program.

SIGNATURE OF AUTHORIZED CERTIFYING OFFICIAL	TITLE
William M. Kier	Principal
APPLICANT ORGANIZATION	DATE SUBMITTED
Kier Associates	4/15/99

Standard Form 424B (Rev. 7-97) Back

I —018061

I-018061